CLAIMS

1. A method for forming an oxynitride film, characterized by comprising providing a solid dielectric on at least one of opposed surfaces of a pair of electrodes opposed to each other under nearly atmospheric pressure, introducing a nitrogen gas containing oxygen or an oxide at higher than 1 ppm and equal to or lower than 0.2% into a space between the pair of opposed electrodes, applying an electric field to the nitrogen gas, and bringing the resulting plasma into contact with an object to be processed to form an oxynitride film on a surface of the object to be processed.

2. A method for forming a nitride film, characterized by comprising providing a solid dielectric on at least one of opposed surfaces of a pair of electrodes opposed to each other under nearly atmospheric pressure, introducing a nitrogen gas containing oxygen or an oxide at equal to or lower than 1 ppm into a space between the pair of opposed electrodes, applying an electric field to the nitrogen gas, and bringing the resulting plasma into contact with an object to be processed to form a nitride film on a surface of the object to be processed.

3. The method for forming an oxynitride film according to claim 1, characterized in that the nearly atmospheric pressure is equal to or higher than 300 Torr.

4. The method for forming a nitride film according to claim 2, characterized in that the nearly atmospheric pressure is equal to or higher than 300 Torr.

5. The method for forming an oxynitride film according to claim 1, characterized in that the nearly atmospheric pressure is a pressure at which an N_2 (H.I.R) and/or N_2 (2^{nd} p.s.) active species appears dominantly as active nitrogen species observed by optical emission spectroscopy.

6. The method for forming an oxynitride film according to any one of claims 1, 3, and 5, characterized in that the gas atmosphere under nearly atmospheric pressure in which the

plasma is obtained is a gas atmosphere in which emission of light derived from NO-γ is observed by optical emission spectroscopy.

7. The method for forming a nitride film according to claim 2, characterized in that the nearly atmospheric pressure is a pressure at which an N_2 (H.I.R) and/or N_2 (2^{nd} p.s.) active species appears dominantly as active nitrogen species observed by optical emission spectroscopy.

8. The method for forming an oxynitride film according to claim 1, characterized in that an N_2 (2^{nd} p.s.) and/or N_2 (H.I.R) active species is dominant in the plasma as active nitrogen species observed by optical emission spectroscopy.

9. The method for forming a nitride film according to claim 2, characterized in that an N_2 (2^{nd} p.s.) and/or N_2 (H.I.R) active species is dominant in the plasma as active nitrogen species observed by optical emission spectroscopy.

10. The method for forming an oxynitride film according to any one of claims 1, 3, 5, 6, and 8, characterized in that only neutral active species is present in the plasma as active nitrogen species observed by optical emission spectroscopy.

11. The method for forming a nitride film according to any one of claims 2, 4, 7, and 9, characterized in that only neutral active species is present in the plasma as active nitrogen species observed by optical emission spectroscopy.

12. The method for forming an oxynitride film according to any one of claims 1, 3, 5, 6, 8, and 10 characterized in that the plasma is brought into contact with the object to be processed in a diffusion region outside the discharge space between the opposed electrodes.

13. The method for forming a nitride film according to any one of claims 2, 4, 7, 9, and 11, characterized in that the plasma is brought into contact with the object to be processed in a diffusion region outside the discharge space between the opposed electrodes.

14. The method for forming an oxynitride film according to any one of claims 1, 3, 5, 6, 8, 10, and 12, characterized in that the solid dielectric is a dielectric containing substantially no oxide.

15. The method for forming a nitride film according to any one of claims 2, 4, 7, 9, 11, and 13, characterized in that the solid dielectric is a dielectric containing substantially no oxide.

16. The method for forming an oxynitride film according to any one of claims 1, 3, 5, 6, 8, 10, 12, and 14, characterized in that the object to be processed has a surface temperature of 50°C or higher, more preferably 100°C or higher.

17. The method for forming a nitride film according to any one of claims 2, 4, 7, 9, 11, 13, and 15, characterized in that the object to be processed has a surface temperature of 50°C or higher, more preferably 100°C or higher.

18. The method for forming a nitride film or an oxynitride film according to any one of claims 2, 4, 7, 9, 11, 13, 15 and 17, characterized in that the nitrogen gas is a high-purity nitrogen gas containing oxygen or an oxide at preferably 1 ppb or less.

19. An oxynitride film formed on a surface of an object to be processed by applying an electric field to a nitrogen gas containing oxygen or an oxide at higher than 1 ppm and equal to or lower than 0.2%, and bringing the object to be processed into contact with the resulting plasma.

20. A nitride film formed on a surface of an object to be processed by applying an electric field to a nitrogen gas containing oxygen or an oxide at equal to or lower than 1 ppm, more preferably equal to or lower than 1 ppb, and bringing the object to be processed into contact with the resulting plasma.

21. A substrate having on its surface an oxynitride film formed by applying an electric field to a nitrogen gas containing oxygen or an oxide at higher than 1 ppm and equal to or lower than 0.2%, and bringing an object to be processed into contact with the resulting plasma.

22. A substrate having on its surface a nitride film formed by applying an electric field to a high-purity nitrogen gas containing oxygen or an oxide at equal to or lower than 1 ppm, more preferably equal to or lower than 1 ppb, and bringing an object to be processed into contact with the resulting plasma.

23. An apparatus for forming a nitride film and an oxynitride film, characterized by comprising a pair of opposed electrodes with a solid dielectric containing no oxide being provided on at least one of opposed surfaces; a mechanism for introducing a nitrogen gas containing oxygen or an oxide at equal to or lower than 0.2% into a space between the pair of opposed electrodes; a mechanism for applying an electric field to the space between the electrodes; and a mechanism for bringing plasma obtained by the electric field into contact with an object to be processed.

24. The apparatus for forming a nitride film and an oxynitride film according to claim 23, characterized in that the mechanism for bringing the plasma into contact with the object to be processed is a direct-type mechanism which directly brings the plasma generated in the discharge space between the opposed electrodes into contact with the object to be processed.

25. The apparatus for forming a nitride film and an oxynitride film according to claim 23, characterized in that the mechanism for bringing the plasma into contact with the object to be

processed is a remote-type mechanism which brings the plasma generated in the discharge space between the opposed electrodes into contact with the object to be processed in a diffusion region outside the discharge space between the opposed electrodes.

26. The apparatus for forming a nitride film according to claim 25, characterized in that the remote-type mechanism which brings the plasma into contact with the object to be processed in the diffusion region has a blowing nozzle formed on the solid dielectric to guide the plasma generated in the space between the opposed electrodes toward the object to be processed placed outside the discharge space between the opposed electrodes.